Project Title: Lewiston – Clarkston Valley Formaldehyde Study (Community-Scale Monitoring)

Applicant: Nez Perce Tribe
Environmental Restoration & Waste Management Division
Air Quality Program
P.O. Box 365
Lapwai, ID 83540

Julie Simpson, Air Quality Program Coordinator
phone 208.621.3818
fax 208.843.7411
julies@nezperce.org

Funding Requested: $418,789

Total Project Cost: $418,789

Project Period: May 1, 2015 - April 30, 2018

DUNS number: 078208303

Basis and Rationale: Submitted to the Community-Scale Monitoring category, the proposed *Lewiston-Clarkston (LC) Valley Formaldehyde (HCHO) Study* will identify sources of elevated carbonyls found in the year long community monitoring assessment the Nez Perce Tribe (NPT) conducted in 2006/2007 in the Lewiston-Clarkston Valley (LC Valley) and on the Nez Perce Reservation in North Central Idaho. *(http://www.nezperce.org/Official/Air%20Quality/Airtoxics/airtoxics.htm).*

Data analysis results and recommendations competed by Sonoma Technology, Inc. for the 2006/2007 study clearly identified the need for additional research (McCarthy et al, 2009):

> Concentrations of formaldehyde [HCHO] and acetaldehyde were much higher than expected for an area of Lewiston's size. Because HCHO is the largest contributor to cancer risk among the pollutants measured and acetaldehyde is a significant contributor, this result is significant. Concentrations of HCHO and acetaldehyde were highest in the summer months but did not appear to be related to special events like large wildfires. Secondary production of HCHO and acetaldehyde are most likely to be responsible for the seasonal pattern but it is unclear why concentrations are higher in the Lewiston area than at other sites in the Inland Northwest. Insufficient information is available about local concentrations of anthropogenic and biogenic VOC concentrations to determine why HCHO and acetaldehyde are high. The nearby [pulp and paper] mill may be indirectly responsible for some of the high HCHO and acetaldehyde concentrations, but this hypothesis cannot be tested with the available monitoring data…. Overall, concentrations of HCHO (and acetaldehyde) are high enough, and of sufficient concern for health risk, to be worthy of additional study. (p. 3-1)
>
> Normally, we would consider the seasonal pattern seen in [Figure 1] a simple example of high secondary production, but the episodically high concentrations in the Lewiston area are far higher than those in Boise or La Grande…. Total VOC emissions are very unlikely to be higher in Lewiston than in the Boise area, and biogenic secondary production is unlikely to be responsible for higher concentrations than those in La Grande or Boise. Some combination of high secondary production, topographically trapped concentrations, and high VOC concentrations from anthropogenic and/or biogenic sources may be the most likely cause. (p. 2-18)

The HCHO and acetaldehyde levels in the Lewiston area are comparable to [ambient background] levels that are found in urban areas, but much higher than what is found in rural areas across North America (ATSDR, 2009; McCarthy et al., 2006).

Based on the 2006/2007 data, the combined upper respiratory tract cancer risk level for continual exposure to HCHO and acetaldehyde is 89.0 (80.5 and 8.49, respectively) extra cancers per one million people exposed (ATSDR, 2009).[1] Idaho Division of Health's Bureau of Community and Environmental Health (BCEH) recommended that the Nez Perce Tribe and the Idaho Department of Environmental Quality (IDEQ) continue air monitoring in Lewiston and surrounding areas (ATSDR, 2009).

Currently the community blames large industry for poor air quality. In the previous monitoring, source identification was not fully possible with the one-in-six day, 24 hour sampling scheme used; therefore, we propose intensive sampling with high temporal resolution for short durations to identify sources of HCHO, its precursors, and other air toxics. The community can then develop and implement strategies for reduction if the source of the elevated pollutants in the Lewiston - Clarkston Valley (LC Valley) is known.

The proposed project will be a collaboration between NPT, Idaho Department of Environmental Quality (IDEQ), Idaho Department of Health and Welfare's Environmental Health Education and Assessment Program (EHEAP), and Washington State University (WSU). It will identify the sources of primary HCHO and provide insight on chemistry pathways of secondary HCHO generation. Since HCHO is one of the key pollutants responsible for overall cancer risk nationwide according to the 2005 National-Scale Air Toxics Assessment, this project has relevance well beyond the local area.

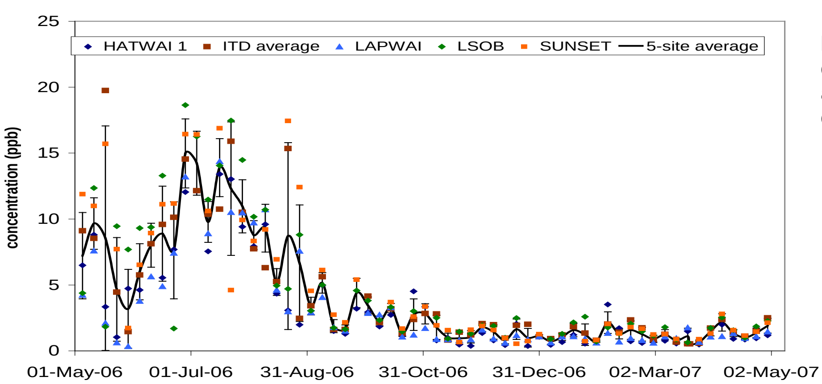


Figure 1. Formaldehyde level concentrations (in ppb) in the LC valley as measured in the 2006/2007 community air toxics study.

Technical Approach: Our project's objective is to identify the source of HCHO by measuring the temporal and spatial variability of HCHO from 3 sites in the valley for a 4 week period in summer. These sites will be

[1] The Inhalation Unit Risk is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 ug/m3 in air.

selected in year 1 with the aim of capturing an upwind and downwind component of valley airflows to augment valley measurements at the so-called intensive site. Sampling will take place in years 2 and 3. The intensive site will host a suite of instruments in a dedicated trailer (WSU's Mobile Atmospheric Chemistry Laboratory) to make continuous measurements of HCHO and other gases as well as surface meteorology. The intensive site measurements will be made with high time resolution (1 minute for HCHO) to define statistically robust tracer relationships. The high time resolution measurements will enable HCHO concentrations to be related to meteorological variables such as wind direction to identify potential impact from point sources. Tracer relationships will determine if the elevated concentrations of HCHO observed in summer are from primary (i.e. industrial emissions from a paper mill operation) or secondary sources from hydrocarbon oxidation. All 3 sites will do 2-a-day 12-hr grab sampling for HCHO and acetaldehyde using 2,4-Dinitrophenylhydrazine (DNPH) cartridges (analyzed by an external lab) and be supplemented by grab sampling into SUMMA canisters for VOC analysis of selected air toxics and other compounds by GC-MS (performed by WSU). The upwind and downwind sites will also have surface meteorology measurements of wind speed, wind direction, temperature, relative humidity, and pressure. This distributed sampling scheme will allow us to determine how spatial gradients of HCHO in the valley are related to potential primary sources. The 12-hr integrated sampling allows us to partition daytime and nighttime differences in HCHO abundance for assessing the relative importance of primary and secondary HCHO sources. Data from the measurement program will be used in two parallel, but complementary modeling approaches to help assess and confirm source-receptor relationships and the importance of HCHO secondary formation. IDEQ will conduct source-receptor modeling of the data as a first modeling component, while WSU will use the data for evaluation and analysis of chemical transport model simulations using the WSU AIRPACT-4 air quality forecast system. Together, the measurement program, analysis of the observations, and comprehensive modeling will form an integrated and comprehensive approach for understanding the sources of HCHO and other air toxics in the LC valley.

<u>Intensive Site Instrumentation</u>: The intensive field site will be located to take advantage of distinct diurnal wind patterns with reference to industrial sources. Two sites from the 2006 monitoring study are potential locations. For these intensive field measurements WSU's Laboratory for Atmospheric Research will deploy the Mobile Atmospheric Chemistry Laboratory (MACL) and associated instrumentation. The MACL is a 20 foot long environmentally controlled instrument shelter with a 10-m crank up meteorological tower. Instruments deployed will include a high sensitivity proton transfer reaction mass spectrometer (PTR-MS), standard research grade NO, NO_2, NOy (Air Quality Design), CO (TECO 48) and ozone (TECO 49) instruments. Surface meteorology will be collected by a WXT-520 weather station. We will also plan to deploy a WSU Vaisala ceilometer on the MACL roof top to collect mixed layer depth information. The PTR-MS measurements will be augmented by grab air sampling into 6-L SUMMA canisters for analysis by GC-MS at WSU's Laboratory for Atmospheric Research (LAR). Grab sampling will be a 12-hr integrated sample to match HCHO sample collection.

The PTR-MS instrument (Ionicon Analytik) will measure the air toxics HCHO, acetaldehyde, benzene, and other species listed in Table 1. The PTR-MS instrument is calibrated using external VOC standards diluted with humid zero air. HCHO response is determined using a permeation tube (KinTek). For other VOCs, including acetaldehyde, methanol, isoprene, acetonitrile and a suite of aromatics, instrument response is determined in the field by periodic calibration with a multicomponent gas standard (Scott Marrin) diluted to 20 ppbv with humid zero air. The WSU PTR-MS instrument operates with sample dehumidification so that it can operate at a drift field condition (an E/N ratio of 80 Townsends) that reduces fragmentation, and significantly improves sensitivity to HCHO (Jobson and McCoskey, 2010). No significant interferences have been reported for HCHO and acetaldehyde measurements by PTR-MS (Whisthaler et al., 2008; deGouw and Warneke, 2007). We have operated the PTR-MS in this way for a number of urban field experiments in both summer and winter and it has provided robust data on aldehyde abundance. HCHO and acetaldehyde data from PTR-MS will be compared with DNPH cartridge measurements at the intensive site.

The species to be measured by GC-MS are listed in Table 2 and include a range of hydrocarbons emitted from roadway sources, biogenic sources, and several chlorinated organics. The GC-MS analysis of canister samples provide confirmation of several VOCs identified by the PTR-MS. In particular, PTR-MS measurements of benzene can have positive interferences from ethylbenzene and other monocyclic aromatics (Rogers et al., 2006; Jobson et al., 2010), but this will be significantly reduced by sample drying and operation at a low ion drift field intensity (Jobson and McCoskey, 2010). The canister analysis will be done using a custom built preconcentration system and analysis on a Varian gas chromatograph ion trap mass spectrometer. Separation is performed on a 50-m HP-624 column that is currently optimized for the separation of C_6-C_{11} hydrocarbons. Instrument response is determined by dynamically diluting a 52 component gas standard trace gas (Air Liquide).

Data Analysis: Our approach is based on the assumption that correlations between HCHO and other VOCs and trace gases would indicate the primary and secondary origins of HCHO and that such relationships can be used to quantify the relative impact of biogenic and anthropogenic emission of HCHO in the LC Valley. The advantages of the PTR-MS over traditional VOC methods such as grab sampling are the high time resolution and continuous nature of the measurements along with limited sample handling. Typically a suite of ions, such as listed in Table 1, is measured with 1 minute time resolution and the instrument can operate 24 hours a day. The high time resolution allows insights to be made on sources and sinks of pollutants, in particular those that are suspected of having point sources where infrequent plumes may impact a sampling location. The project will generate a statistically robust data set to determine meteorological influences such as wind direction on primary and secondary VOC mixing ratios.

Oxidation of both anthropogenic and biogenic VOCs, in particular isoprene, can be significant sources of secondary HCHO. Strong secondary sources of HCHO have been identified by its co-variation with other photochemical products such as ozone and peroxyacyl nitrates (PAN) (Rappengluck et al., 2010). Figure 2 shows an example where the variation of HCHO mixing ratios during the day is driven by the photochemical oxidation of isoprene. These data were also collected by the WSU PTR-MS and illustrate how isoprene and its oxidation products HCHO, methyl vinylketone (MVK) and methacrolein (MACR) maximize during the day when isoprene and oxidant concentrations are highest. A strong correlation between HCHO and the sum of MVK+MACR indicates the photochemical origin of HCHO. Conversely, the lack of a good correlation between HCHO and CO indicates that roadway emissions are not a major source of HCHO in this environment.

In the LC Valley we will measure a suite of trace gases to identify correlations between HCHO and other gases to establish sources of HCHO. Primary sources that must be considered are a large paper mill located in Lewiston, a large composting facility in the same vicinity, and mobile emissions throughout the valley. Emission inventories indicate the paper mill is a significant source of methanol (730 tons / yr) with smaller emissions of acetaldehyde (162 tons / yr) and HCHO (35 tons / yr) with few other VOCs emitted. The mill is also a significant point source of NOx (2365 tons / yr). Methanol in this case would be a good tracer of the mill's plume. Other compounds are also likely emitted from the mill including compounds that give rise to its distinct odor such as hydrogen sulfide (H_2S) and other mercaptons that could be measured by PTR-MS. Grab sampling done in 2003 indicated that the mill may also be a source of several chlorinated organic compounds such as $CHCl_3$.

Table 1. Compounds to be measured with PTR-MS.

m/z (mass to charge)	Compound	Notes
Oxygenated species		
31	formaldehyde[(1)]	air toxic / photoproduct
33	methanol	pulp mill emission tracer
45	acetaldehyde[(1)]	air toxic / photoproduct
49	methyl hydroperoxide	photoproduct
59	acetone + propanal	solvents + photoproducts
71	MVK + MACR[(2)]	isoprene photoproducts
73	2-butanone	solvents
Aromatic compounds		
79	benzene[(1)]	air toxic / vehicle emissions
93	toluene	vehicle emissions / industrial
105	styrene	industrial
107	C_2 benzenes (C_8H_{10})	vehicle emissions
121	C_3 benzenes (C_9H_{12})	vehicle emissions
135	C_4 benzenes ($C_{10}H_{14}$)	vehicle emissions
Biogenic emissions		
69	isoprene	biogenic emission
137	monoterpenes	biogenic emission
139	nopinone	b-pinene oxidation product
Industrial tracers		
35	hydrogen sulfide (H_2S)	potential pulp mill tracer
Biomass burning tracers		
42	acetonitrile	biomass burning tracer

(1) HAP species of interest to LC Valley air quality
(2) methyl vinylketone (MVK) and methacrolein (MACR)

Table 2. Compounds to be measured by GC-MS.

Alkanes		
hexane	2-metylhexane	nonane
2-methypentane	octane	decane
3-methylpentane	2,2,4-trimethylpenatne	
heptanes	2,3,4-trimethylpentane	
Aromatics		
benzene(1)	isopropylbenzene	1,2,3-trimethylbenzene
toluene	styrene	1,2,4-trimethylbenzene
ethylbenzene	2-ethyltoluene	1,3,5-trimethylbenzene
m.p-xylene	3-ethyltoluene	n-butylbenzene
o-xylene	4-ethyltoluene	i-butylbenzene
Industrial tracers		
dichloromethane	chloroform(1)	tetrachloroethylene(1)
1,1,1-trichloroethane	trichloroethylene(1)	
Biogenics		
isoprene	b-pinene	myrcene
a-pinene	limonene	a-phellandrene

(1) HAP species of interest to LC Valley air quality

The mill might also be a significant source of VOCs associated with emissions from wood chips and operation of drying kilns. The photochemical oxidation of mill VOC emissions may be a secondary source of HCHO. Particularly relevant is that HCHO can be formed from the HO initiated oxidation of methanol. The major reaction pathway (84%) is:

$$HO^{\bullet} + CH_3OH \rightarrow {}^{\bullet}CH_2OH + H_2O \qquad R1$$
$${}^{\bullet}CH_2OH \rightarrow HCHO + HO^{\bullet} \qquad R2$$

The HO + methanol rate constant is relatively slow ($k_{R3} = 7.9 \times 10^{-13}$ cm^3 molecule^{-1} s^{-1}, Atkinson et al., 2005) but large emissions of methanol from the mill in summer may yield rapid formation of HCHO. Note HO radicals are regenerated in the decomposition of the CH_2OH radical (R2) making it an efficient chain oxidation mechanism in both low and high NOx environments. Methanol mixing ratios have not been measured in the LC Valley. The general observations of HCHO to date in the LC Valley show high HCHO during summer, suggesting that it is photochemical in nature. Contrasting relationships between sunny and cloudy days, and correlations between HCHO and other photoproducts such as CH_3OOH, O_3, and NOy, will enable us to determine if the high HCHO is due to photochemical production from mill VOC emissions.

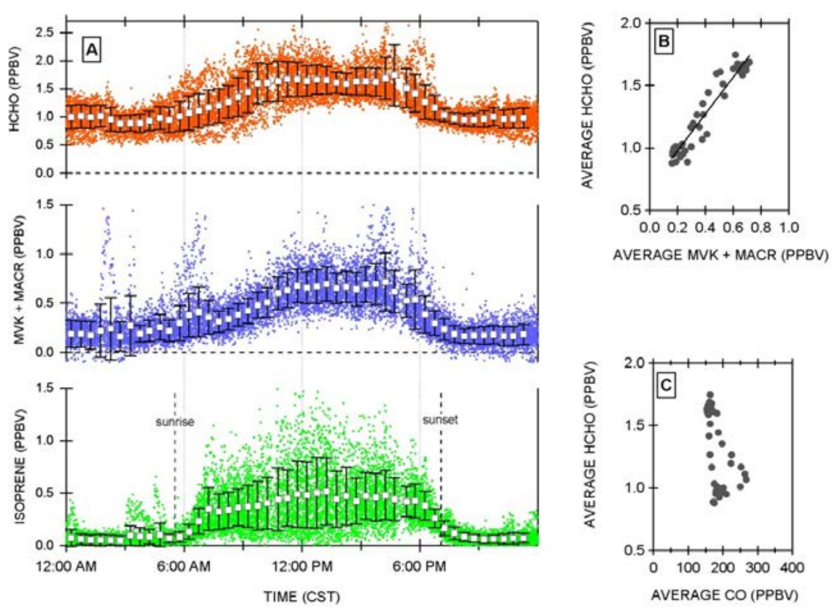


Figure 2. Panel A displays the diurnal variation of isoprene and its oxidation products HCHO and methacrolein (MACR) and methylvinyl ketone (MVK) for a 2 week period in May in Houston, TX to illustrate the time resolution of PTR-MS measurement. Symbols and error bars represent ½-hr averages and standard deviations. Panels B and C show correlations of ½-hr averaged data. MVK + MACR is a tracer of isoprene oxidation chemistry. CO is a tracer for spark ignition vehicles.

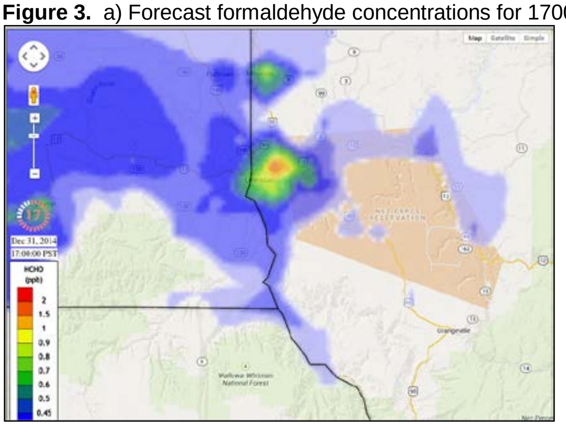
<u>Statistical Analysis</u>: The high time resolution VOC and aldehydes data from the PTR-MS instrument will be analyzed using one or more receptor modeling techniques such as Positive Matrix Factorization and Principal Cluster Analysis to identify potential source categories. By including wind data, solar radiation,

carbon monoxide and known VOC tracer compounds, the relative contributions from biogenic emissions, wildfires, other biomass burning, motor vehicle emissions and industrial source categories will be identified. In addition, any primary aldehydes emitted directly from suspected sources should be distinguishable from secondary aldehydes resulting from the daytime photochemistry through an analysis of concentration and wind directions and/or from specific HCHO/tracer relationships.

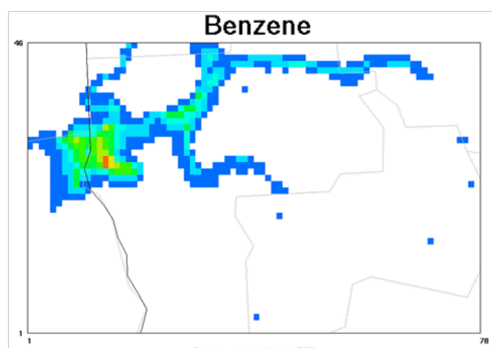
Health Risk Analysis: Additional analysis of the data generated includes an ATSDR Public Health Consultation (PHC). The PHC will review site-related environmental data and general information about toxic substances measured during the monitoring. From environmental data and information gathered from the community, an estimated exposure will be derived and then compared to health-based comparison levels to determine if exposures to people in the community might place them at risk of disease and illnesses associated with those chemicals.

Comparison to Forecast Model: Concentrations for the various measured species from the field studies will be compared with AIRPACT air quality forecasts at 4 km resolution to help assess and confirm the sources of air toxics within the study area. AIRPACT (Air Indicator Report for Public Access and Community Tracking), is an advanced air quality forecast system for the Pacific Northwest reporting to the public daily via the web (http://lar.wsu.edu/airpact/). The AIRPACT system employs meteorological forecasts from the Weather Research and Forecasting (WRF) model with the Community Multi-scale Air Quality (CMAQ) model to explicitly treat the emissions, transport and transformation of gas and aerosol pollutants. This includes explicit treatment of HCHO primary emissions from the mobile sources and from the pulp mill in the LC valley as well as photochemical formation of secondary HCHO due to NOx and VOC precursor chemistry. An example of wintertime HCHO concentration patterns from AIRPACT is shown in Figure 3a. This modeling framework provides a significant addition to our capabilities to understand the evolution of air toxic patterns within the valley. We will also investigate the possibility of using AIRPACT with 1.3 km grids which would better capture the diurnal wind patterns in the valley. In this case, the 4 km emission inventory would be re-sampled at 1.3 km and used with WRF meteorological forecasts fields at 1.3 km. We conducted similar high resolution model runs for air toxics in the LC valley previously as illustrated in Figure 3b (Ramos, 2008).

Figure 3. a) Forecast formaldehyde concentrations for 1700 Dec 31, 2014 for the LC Valley from the AIRPACT air quality forecast system http://lar.wsu.edu/airpact/.



b) 1 km gridded simulation using CMAQ for benzene in the LC valley (Ramos, 2008).



Environmental Justice Impacts: The environmental justice community involved with the *LC Valley HCHO Study* includes the Nez Perce Tribe, the Nez Perce Reservation and portions of the LC Valley. At 18,000 people, the population of the Nez Perce Reservation is the second largest reservation population in EPA Region 10. The LC Valley has a combined population of 49,300 residents.

Of the 3,000 members enrolled in the Nez Perce Tribe, about 2,000 live on the Reservation or in the LC Valley. Because 2/3 of the entire population of the Nez Perce Tribe resides in this area affected by the HCHO concentrations of concern, the Nez Perce Tribe is disproportionately and significantly impacted by these environmental harms and risks, as is the entire community of study.

According to EPA Region 10's Environmental Justice Maps, the LC Valley and westernmost portions of the Nez Perce Reservation have census blocks with 14 to 22 percent of people living below the poverty level. (http://yosemite.epa.gov/R10/ocrej.nsf/environmental+justice/maps)

One of the goals of the Nez Perce Tribe's Department of Natural Resources is to protect the health of the Tribal public through sound land management practices and protection of all environmental resources, above all, protecting, preserving and perpetuating all cultural resources necessary to the Nez Perce way of life (http://www.nezperce.org/official/departmentofnaturalresources.htm). The goal of the Tribe's Air Quality Program is to protect human health and the environment through education and outreach projects, capacity building, and surveys, studies and investigation projects that address the Tribe's air quality issues and concerns on the Nez Perce Reservation, within the Clearwater Airshed, and within the Tribe's usual and accustomed treaty lands.

Information from the *LC Valley HCHO Study* will increase the knowledge of sources and understanding of chemistry pathways of HCHO generation. Once the community determines the source of the elevated pollutants, strategies for reduction can be developed and implemented, resulting in a decrease in health risk.

Community Collaboration/ Outreach: Collaboration and outreach with the community is an important element of the *LC Valley HCHO Study*. This study will utilize existing collaboration avenues of education and outreach with the community as well as stand-alone meetings.

The Nez Perce Tribe's AQ Program has a strong history of education and outreach. Nez Perce Tribal members have consistently expressed concern about emissions from local industry and transportation. Addressing these concerns ultimately led to the 2006/2007 air toxics study. The Nez Perce Tribe created a public access webpage with the results of the 2006/2007 toxics sampling study (http://www.nezperce.org/Official/Air%20Quality/Airtoxics/airtoxics.htm). Nez Perce Tribe community members concerned with local air quality issues also are kept informed through the Ta'c Tito'oqan, the tribal newspaper.

Over the years many area students have learned about air toxics and air quality issues at schools and summer camps, resulting in a young generation with an interest in regional air quality. Examples include ten years of air quality lessons at PACE (Preparing students for ACademic Excellence, a Nez Perce Tribe summer math and science camp) and collaboration with Northwest Indian College's Nez Perce Reservation campus to provide air quality internships and projects for students. Each fall during the school year the University of Montana (UM) gives air presentations and delivers air sampling equipment for students to measure particulate matter and participate in the Clean Air and Healthy Homes Program and UM Big Sky Symposium. In 2009, Lapwai High School was one of the EPA School Air Toxics (SAT) study sites, and in 2010, the Lapwai team used the SAT data for their award winning presentation at the Big Sky Symposium. Air quality information has also been presented at adult classes and to existing organizations and advisory groups, such as the LC Air Quality Advisory Commission, the Nez Perce Tribe Fish and Wildlife Commission, and the Nez Perce Prairie Grass Growers Association. NPT, IDEQ and EHEAP regularly work with Idaho's North Central District Public Health Department on joint air quality messages in several local papers and Facebook regarding impacts from wildfire smoke to health.

Over the last three years IDEQ has worked with Lewis Clark State College's (LCSC) Natural Resources Program to educate students on real-world environmental issues and develop awareness of environmental monitoring and regulations. IDEQ's involvement has included leading group discussions in Sustainability and Natural Sciences classes to educate students on environmental sampling techniques, protection of natural resources, and awareness of environmental regulations. Additionally, IDEQ maintains communications with LCSC programs and staff to further environmental awareness and involvement in the natural resource and industry classes for air quality and human health. IDEQ also works with the University of Idaho's Forestry and Fire Ecology program to educate students on the importance of air quality and smoke management. Over the last two years IDEQ staff have presented air quality information including, awareness of National Ambient Air Quality Standards and human health concerns related to PM2.5, meteorological impacts on smoke management, and State air quality rules for open burning, prescribed burning, and permitting.

The NPT and IDEQ collaborated with EHEAP on the 2006/2007 toxics study and development of the *LC Valley HCHO Study*. Having the support of EHEAP for further research has been very important. EHEAP has committed to working with the NPT and IDEQ on the evaluation of health risks and provision of community outreach and education throughout the study if funded. We will work together to hold community information exchange sessions prior to the start of sampling, during, and after study results are completed.

Environmental Results: Outcomes, Outputs, and Performance Measures: The LC Valley HCHO Study will support progress toward EPA's 2014-2018 Strategic Plan Goal 1 "Addressing Climate Change and Improving Air Quality." This proposed study will advance the understanding of air toxics science, impacts, and mitigation approaches. The study will also provide insights for developing strategies to reduce air toxics emissions and hazardous air pollutants (HAPs) that will have substantial environmental and human health benefits. Ambient HAP concentrations for the intensive sampling periods will be summarized and made available, along with the ATSDR Health Consultation, in reports and presented to news media, industry, and the public.

NPT AQ Program staff will work with EPA Air Quality System (AQS) personnel to establish method codes in AQS for data entry and enter the data. Comparisons with AIRPACT will be evaluated to see if the AIRPACT emission inventory input is missing a secondary source or determine if there is a seasonally dependent primary emission of HCHO that needs to be added to make AIRPACT a more useful community forecasting tool.

In the short-term, this project will quantify and identify the sources of the elevated summer HCHO concentrations and increase community and industry awareness about air toxics and HAPs. Mid-term and long-term outcomes are dependent on findings, but we anticipate community or industry action to reduce emissions, ultimately resulting in reduced ambient concentrations of HAPs, as well as action to reduce exposure to HAPs. Long-term outcomes include reduced HAP emissions, reduced ambient HAP concentrations, reduced human exposure to HAPs and reduced adverse health effects from HAPs. For example, if we find that monoterpenes from paper feedstock plays a large role, the mitigation may be to reduce on-site stockpiles of chipped materials. Alternatively, if the compost industry plays a role, one action may be to implement mitigation measures like covering piles with finished compost or bio-filters to reduce emissions.

Outputs and performance measures are listed in Table 3. Performance measures for the data collection include confirming VOCs identified with PTR-MS with GC-MS to ensure VOCs are not misidentified. Data capture will meet QAPP guidelines. Quarterly progress reports will be submitted to EPA documenting technical progress, planned activities for the next quarter, and a summary of expenditures. At the conclusion of the project output phase, an interim final report will be submitted to EPA summarizing the project, advances achieved, costs, the degree to which the project output goals and objectives were met, and prognosis for achieving the short- and mid-term project outcomes. Within 90 days of the end of the project period, the final report will be submitted to EPA and will provide updated and expanded detail and documentation to include the degree to which the short- and mid-term project outcomes were achieved as well as a description of achievements for the remaining mid- and long-term outcomes. The final technical report will also discuss the problems, successes, and lessons learned from the project that could help overcome structural, organizational and technical obstacles to implementing a similar project elsewhere.

Table 3. Outputs and performance measures.

Task	**Deliverable**	**Responsible party**	**Timeline**
EPA awards grants	Funding	EPA	Spring 2015
PROJECT PERIOD BEGINS			May 1, 2015
Quarterly progress reports to EPA	Quarterly Report	NPT	Quarterly – schedule to be established by EPA
Community collaboration, education & outreach – study design	Community info. sessions, informational notice, newspaper article	EHEAP, NPT, IDEQ, WSU	Prior to sampling July 2016, minimum of 2 community info sessions, 1 informational notice & 1 article.
Finalize site selection	Site located and power needs addressed	NPT, IDEQ, WSU	October 2015
Complete and submit QAPP to EPA	QAPP	WSU, NPT	January 2016
Monitoring equipment tested and calibrated	Equipment in proper working order and calibrated	NPT, IDEQ, WSU	April 2016 and April 2017
Finalize site preparation	Sites developed, power installed, equipment deployed	NPT, IDEQ, WSU	June 2016 and June 2017
Community collaboration, education & outreach – sampling period	Community info. sessions, informational notice, newspaper article	EHEAP, NPT, IDEQ, WSU	July 2016 – July 2017, minimum of 4 community info sessions, 1 informational notice & 1 article.
Summer 2016 sampling & AQS submittals	Data collection and analysis	WSU	Monitoring: 4 weeks July 2016. AQS: data uploaded within 6 months after monitoring.
Summer 2017 sampling & AQS submittals	Data collection and analysis	WSU	Monitoring: 4 weeks July 2017. AQS: data uploaded within 6 months after monitoring.
Interim final report to EPA	Interim Final Report	NPT	November 1, 2017
Community collaboration, education & outreach – results and recommendations	Community info. sessions, informational notices, newspaper articles	EHEAP, NPT, IDEQ, WSU	Minimum of 4 community info sessions, 2 informational notices & 2 articles: January-April 2018
ATSDR Health Consultation	Health Consultation	IDPH	March 2018
Presentation(s) at EPA nat'l conference	Presentation	NPT	Exact date(s) (prior to April 30, 2018) to be determined
PROJECT PERIOD ENDS			April 30, 2018
Final report	Final Report	NPT, WSU	July 31, 2018

Programmatic Capability and Past Performance: The Nez Perce Tribe AQ Program has the organizational and staff experience, expertise and qualifications to complete and manage the proposed project. The AQ Coordinator has worked for the NPT for 19 years managing and administering grants and contracts, and the Environmental Specialist has worked for the NPT for 9 years operating and maintaining AQ monitoring equipment, conducting inspections, analyzing data, submitting data to AQS, working with the public, students, and regulated community, and giving presentations about study results to various audiences.

The NPT AQ Program has successfully managed and completed projects of similar scope within the last three years. These are:

- EPA Assistance Agreement DI-00J46101; 2011-2016 (in progress); $2,492,615: Direct Implementation Tribal Cooperative Agreement (DITCA) for implementation of the Federal Air Rules for Reservations (FARR) on the Nez Perce Reservation, including smoke management and burn permitting; FARR and Title V source inspections; complaint response; compliance assistance, assurance and monitoring; operation and maintenance of three stationary continuous PM2.5 sites, four met stations, and two portable PM2.5 samplers; coordination with other jurisdictions; and work with public and regulated community. Successfully completing and managing DITCA to meet reporting requirements and outcomes and outputs. Adequate and timely progress reports on outputs and outcomes have been made to EPA project officer both verbally and through submitted reports.
- EPA Assistance Agreement TX-00J80401; 2013-2015 (in progress); $313,816: Clean Air Act 103 Grant, including projects involved with air toxics, air quality and climate change, Western Regional Air Partnership, NW-AirQuest, and education and outreach. Ongoing collaborations with other tribal, local, state, federal agencies and institutions. Successfully completing and managing grant to meet reporting requirements and outcomes and outputs. Adequate and timely progress reports on outputs and outcomes have been made to EPA project officer both verbally and through submitted reports.

Detailed Budget: The detailed budget is explained in Table 4. NPT personnel will oversee the contracts, facilitate cooperation between entities, and administer the grant. A subcontract with WSU will provide the personnel, equipment, and consumables for the ambient gas measurements. A smaller subcontract is for IDEQ to oversee site selection, outreach needs that arise from the project, and data review. Although project and contractual personnel are identified, in the case of change in staff, equivalent expertise will be utilized.

Table 4. Detailed budget.

PERSONNEL				**22,617**
Project Manager: Simpson	100hrs/yr x 3 yrs		13,434	
Project Staff: Fauci	100hrs/yr x 3 yrs		9,183	
FRINGE BENEFITS	NPT fringe rates: FICA, FICA-Med, SUTA, Wrkmns Comp, Health, Retirement			**4,867**
TRAVEL				**6,448**
Local mileage	500 mi @ $.575/mi		288	
Professional meetings	2 regional and/or national meetings, 2 personnel. Costs estimated to Denver as point of destination, 4 days travel. ($489 for 3 nights lodging), ($231 per diem), ($600 flight), ($60 NPT travel expenses), ($100 cab fare round trip), ($60 airport parking)		6,160	
EQUIPMENT				**0**
SUPPLIES				**5,000**
Site preparation supplies	(5 ATEC carbonyl samplers) 3 sites		4,000	
Outreach supplies	Paper, envelopes, posterboard		1,000	
CONTRACTUAL				**360,767**
External lab analysis	ATEC carbonyl sampler cartridges and analysis: $16,320/yr for years 2&3: 192 samples per year, 3 sites, 2 per day, 28 days, plus 10% extra & blanks		32,640	
Idaho Dept of Env'l Quality	Total Costs Years 1-3		39,610	
	Personnel - Rand, Analyst 4, 200hrs	5,844		
	Personnel - Hiebert, Analyst 3, 125 hrs	2,750		
	Personnel - Bishop, Analyst 3, 100 hrs	2,492		
	Personnel - Brown, Analyst 3, 40 hrs	957		
	Personnel - Hardy, Scientist 5, 40 hrs	1,496		
	Personnel - Dong, Scientist 4, 240 hrs	7,438		
	Fringe Benefits @ 44%	9,230		
	Indirect @ 31.13%	9,403		
Washington State University	Total Costs Years 1-3		288,517	
	Personnel[1] - Jobson, Principal Investigator, .5 mos/yr x 3yrs	32,960		
	Personnel[1] - Lamb, Co-P.I., .25 mos/yr x 3yrs	13,720		
	Personnel[1] - Pressley, Co-P.I., 2 mos/yr, years 2&3	22,277		

	Personnel[2] - O'Keeffe, Technician, 2 mos/yr x 3yrs	18,249		
	Personnel[3] - Ph.D. Student, data collection & analysis, 12 mos/yr, years 2&3	51,785		
	Fringe Benefits[1,2,3]: 26.9%, 29.9%, 64.8%	57,565		
	Travel: Field Deployment, years 2&3 - WSU motor pool car rental ($37/day x 28days x 2yrs), per diem ($46/day x 32days x 2yrs), lodging ($83/day x 32days x 2yrs)	10,328		
	Supplies / Field instrumentation deployment, consumables, calibration, site prep. 4 wks, yrs 2&3: $5,800 PTR-MS; $4,800 O3, CO, NOx consumables; $11,544 MACL; $5,800 GS-MS	27,944		
	Overhead @ 26%	53,689		
OTHER				**7,300**
Calibration and repair of ATEC equipment	5 samplers		5,000	
Community mtg room costs	Est. $200/mtg x 5 mtgs (5 add'l mtgs will be at existing community events/mtgs)		1,000	
Printing/mailing/newspaper	Informational notices and articles for community education & outreach		1,000	
Phones			300	
DIRECT COSTS				**406,999**
INDIRECT COSTS	FY2015 Fed. Neg. Ind. Cost Rate 25.5% x (Direct Costs less Contractual Costs)			**11,790**
TOTAL PROJECT COST				**418,789**

Leveraging: Existing resources leveraged for this proposal include two fixed meteorology stations in the LC Valley, one operated by NPT and the other by IDEQ, five ATEC carbonyl samplers provided by NPT, and PTR-MS, O3, CO, NOx, MACL, and GS-MS equipment provided by WSU. By making multiple measurements across pollutant groups with different instruments, each suite of analyses leverages the preceding one. Expertise of WSU faculty with the AIRPACT model is leveraged and data will help validate air toxics forecasts at the 4 km resolution. Expertise of EHEAP to provide community outreach and education and ATSDR health consultation is leveraged. Existing avenues for public and student outreach, education, and feedback as identified by the organizations/entities described in the Community Collaboration section above provide further leverage of resources to the project.

REFERENCES

Atkinson,R., D. L. Baulch, R. A. Cox, J. N. Crowley R. F. Hampson, R. G. Hynes, M. E. Jenkin, M. J. Rossi, and J. Troe, Evaluated kinetic and photochemical data for atmospheric chemistry: Volume II – reactions of organic species, *Atmospheric Chemistry and Physics*, 5, 6295, 2005.

ATSDR, Health Consultation: Evaluation of potential health effects from air toxics, Lewiston air toxics monitoring 2006-2007, 2/18/2009, Revised 9/3/2009.

Hansel, A., A. Jordan, R. Holzinger, P. Prazeller, W. Vogel, W. Lindinger, Proton transfer reaction mass spectrometry: on-line trace gas analysis at the ppb level, *Int. J. Mass Spectrom. Ion Proc*. 149/150, 609-619, 1995.

deGouw, J.A., and K. Warneke, Measurements of volatile organic compounds in the eraths atmopshere using proton transfer reaction mass spectrometry, *Mass Spec. Review*., 26, 223-257, 2006.

Friedfeld, S. *et al.*, Statistical analysis of primary and secondary atmospheric formaldehyde, *Atmospheric Environment,* 36, 4767, 2002.

Jobson, B.T. and J.K. McCoskey, Sample drying to improve HCHO measurements by PTR-MS instruments: laboratory and field measurements**,** *Atmospheric Chemistry and Physics*, 10, 1-15, 2010a.

Jobson, B.T., R.A. Volkamer, E. Velasco, G. Allwine, H. Westberg. B.K. Lamb, M/L/ Alexander, C.M. Berkowitz, L.T. Molina, Comparison of aromatic hydrocarbon measurements made by PTR-MS, DOAS and GC-FID during the MCMA 2003 Field Experiment, *Atmospheric Chemistry and Physics*, 10, 1989-2005, 2010b.

Lindinger, W., Hansel, A., Jordan, A., On-line monitoring of volatile organic compounds at pptv levels by means of Proton-Transfer-Reaction Mass Spectrometry (PTR-MS) Medical applications, food control and environmental research, *Inter. J. Mass. Spectro. Ion Proc*. 173, 191-241,1997

McCarthy, M.C., H.R. Hafner, S.A. Montazka, Background concentrations of 18 air toxics for North America, J. Air & Waste Manage. Assoc., 56:3-11, 2006.

McCarthy, M.C., J.M. Stone, T.E. O'Brien, and H.R. Hafner, Sonoma Technology Inc., Lewiston area air toxics data analysis final report STI-909027-3654, 6/30/ 2009.

Possanzini, M., V. Di Palo and A. Cecinato, Sources and photodecomposition of formaldehyde and acetaldehyde in Rome ambient air, *Atmospheric Environment* , 36, 3195, 2002.

Ramos, Charleston, 2008. *Modeling of Air Toxics from Urban and Industrial Sources within Complex Terrain*, M.S. Thesis, Washington State University, 91 pp.

Rappengluck, B., P.K. Dasgupta, M. Leuchner, Q. Li and W. Luke, Formaldehyde and its relation to CO, PAN, and SO2 in the Houston-Galveston airshed, *Atmospheric Chemistry and Physics* 10, 2413, 2010.

Rogers, T.M, Grimsrud, E.P., Herndon, S.C.: On-road measurements of volatile organic compounds in the Mexico City metropolitan area uisng proton transfer reaction mass spectrometry, *Int. J. Mass Sprectrom*., 252, 26-37, 2006.